

650V, 7A N-Channel MOSFET

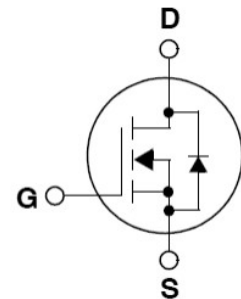
Features

- * $V_{DS} = 650V$, $I_D = 7A$
 $R_{DS(ON)} = 1.2\Omega$ (Typ.) @ $V_{GS} = 10V$
- * Low gate charge (Q_g -typ: 30nC)
- * Low C_{rss} (Typical 16pF)
- * Fast switching characteristics
- * Good stability and improved dv/dt capability
- * Lead free available (RoHS compliant)
- * TO-220AB and TO-220F packages

Applications

- High efficiency Switched Mode Power Supplies
- LED Power Supply

Pin Description and Schematic



N-Channel MOSFET

Package Marking And Ordering Information

Device	Marking (a)	Device Package	Quantity
HCR7N65FT2FBP	HCR7N65F xx	TO-220F	1000pcs/Box
HCR7N65PT22BP	HCR7N65P xx	TO-220AB	1000pcs/Box

Note a. "HCR7N65F" and "HCR7N65P" identify the product; "xx" is the date code.

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Absolute Maximum Ratings

$T_C = 25^\circ\text{C}$, unless otherwise noted

Parameter	Symbol	HCR7N65F	HCR7N65P	Unit
Drain-source voltage ($V_{GS} = 0V$)	V_{DS}	650	650	V
Gate-source voltage ($V_{DS} = 0V$), AC ($f > 1\text{Hz}$)	V_{GS}	± 30	± 30	V
Continuous drain current, $T_C = 25^\circ\text{C}$	I_D	7*	7	A
Continuous drain current, $T_C = 100^\circ\text{C}$	$I_D(100^\circ\text{C})$	4.0	4.0	A
Pulsed drain current (Note 1)	I_{DM}	16*	16	A
Maximum power dissipation	P_D	73	164	W
Derate above 25°C	P_D	0.58	1.31	W/ $^\circ\text{C}$
Single pulsed avalanche energy (Note 2)	E_{AS}	500		mJ
Avalanche current (Note 1)	I_{AR}	7		A
Peak diode recovery dv/dt (Note 3)	dv/dt	5.0		V/ns
Maximum lead temperature for soldering	T_L	300		$^\circ\text{C}$
Operating junction and storage temperature range	T_J, T_{stg}	-55 to 150		$^\circ\text{C}$

Note *. Drain current is limited by maximum junction temperature.

Note 1. Pulse width is limited by maximum junction temperature.

Note 2. $L = 10\text{mH}$, $I_{AS} = 10\text{A}$, $V_{DD} = 100\text{V}$, $R_G = 25\Omega$; starting $T_J = 25^\circ\text{C}$.

Note 3. $I_{SD} \leq 7\text{A}$, $di/dt \leq 100\text{A}/\mu\text{s}$, $V_{DD} \leq BV_{DSS}$; starting $T_J = 25^\circ\text{C}$.

Thermal Characteristics

Parameter	Symbol	HCR7N65F	HCR7N65P	Unit
Thermal resistance, junction to case	$R_{\theta JC}$	1.71	0.76	$^\circ\text{C}/\text{W}$
Thermal resistance, junction to ambient	$R_{\theta JA}$	44	62.5	$^\circ\text{C}/\text{W}$

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Electrical Characteristics

$T_A = 25^\circ\text{C}$, unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
On/Off States						
Drain-source breakdown voltage	BV_{DSS}	$V_{GS} = 0V, I_D = 250\mu A$	650	-	-	V
Breakdown voltage temperature coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D = 250\mu A$, referenced to 25°C	-	0.57	-	$V/^\circ\text{C}$
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 650V, V_{GS} = 0V$	-	0.05	1.0	μA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 520V, T_C = 125^\circ\text{C}$	-	-	100	μA
Gate-body leakage current	I_{GSS}	$V_{DS} = 0V, V_{GS} = \pm 30V$	-	-	± 100	nA
Gate-threshold voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu A$	2.2	2.8	3.8	V
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 3.5A$	-	1.2	1.35	Ω

Dynamic Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Gate resistance	R_g	$f = 1\text{MHz}, V_{DS}$ open	-	3.0	-	Ω
Input capacitance	C_{iss}	$V_{DS} = 25V, V_{GS} = 0V$, $f = 1\text{MHz}$	-	1186	-	pF
Output capacitance	C_{oss}		-	90	-	pF
Reverse transfer capacitance	C_{rss}		-	4	-	pF

Gate Charge Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Total gate charge	Q_g	$V_{DS} = 520V, I_D = 7A$, $V_{GS} = 10V$ (Notes 4, 5)	-	22	-	nC
Gate-source charge	Q_{gs}		-	7	-	nC
Gate-drain charge	Q_{gd}		-	4	-	nC

Notes 4 and 5: see the following page.

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Electrical Characteristics (Continued)

$T_A = 25^\circ\text{C}$, unless otherwise noted

Switching Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Turn-on delay time	$t_{d(on)}$	$V_{DS} = 325\text{V}$, $I_D = 7\text{A}$, $R_G = 10\Omega$ (Notes 4, 5)	-	10	-	ns
Rise time	t_r		-	11	-	ns
Turn-off delay time	$t_{d(off)}$		-	25	-	ns
Fall time	t_f		-	32	-	ns

Drain-Source Diode Characteristics

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Source-drain current (body diode)	I_S	$T_C = 25^\circ\text{C}$	-	-	7	A
Pulsed source-drain current (body diode)	I_{SM}		-	-	16	A
Forward on voltage	V_{SD}	$T_J = 25^\circ\text{C}$, $V_{GS} = 0\text{V}$, $I_{SD} = 7\text{A}$	-	-	1.2	V
Reverse recovery time	t_{rr}	$V_{GS} = 0\text{V}$, $I_S = 7\text{A}$, $di/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	360	-	ns
Reverse recovery charge	Q_{rr}		-	655	-	μC

Note 4. Pulse test: pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

Note 5. Essentially independent of operating temperature.

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Typical Characteristics

$T_J = 25^\circ\text{C}$, unless otherwise noted

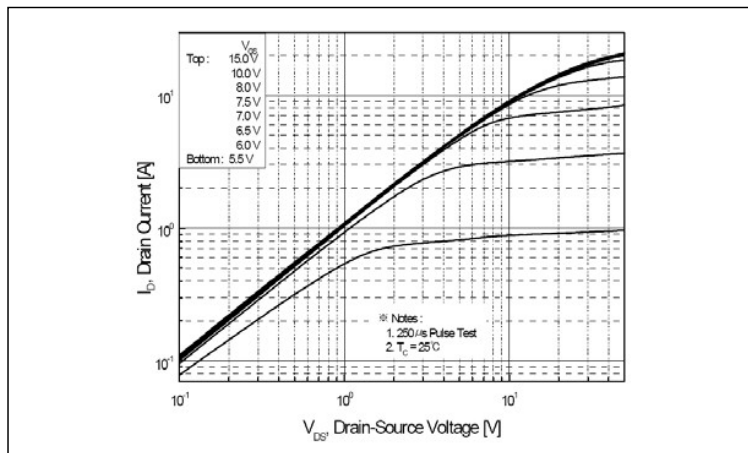


Figure 1. On-Region Characteristics

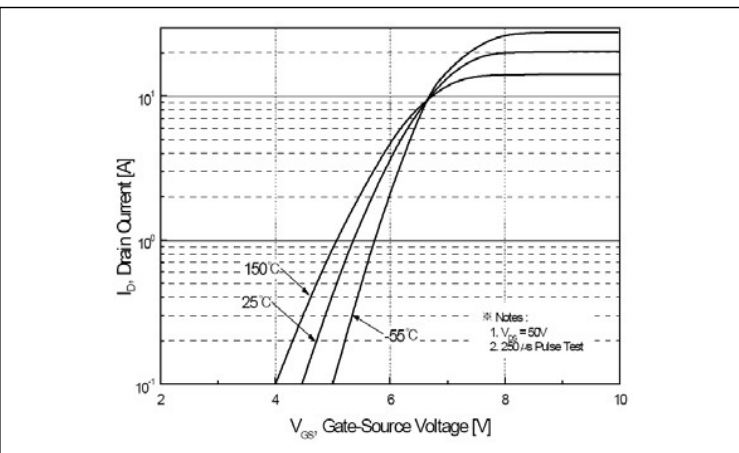


Figure 2. Transfer Characteristics

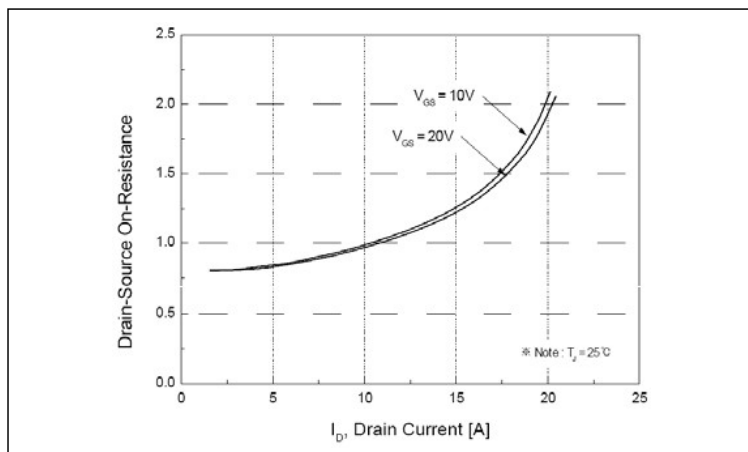


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

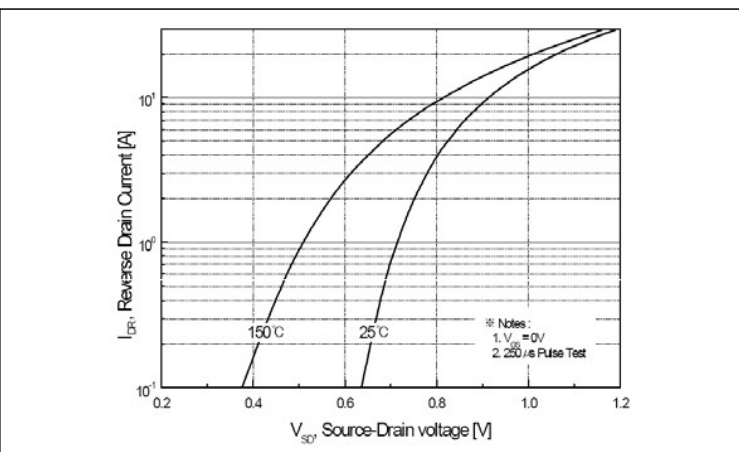


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

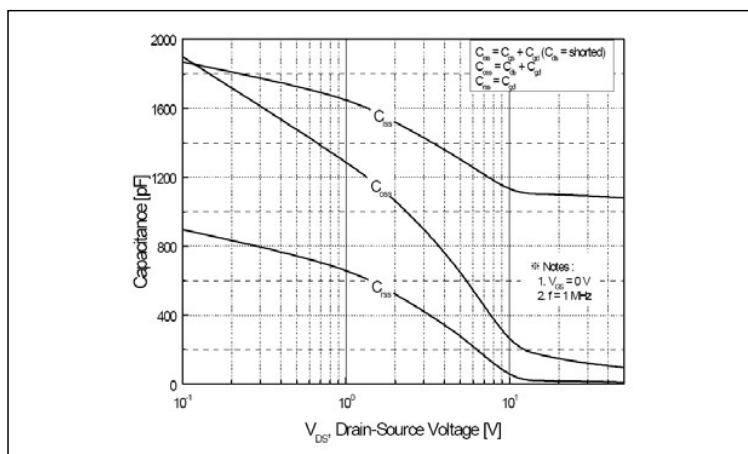


Figure 5. Capacitance Characteristics

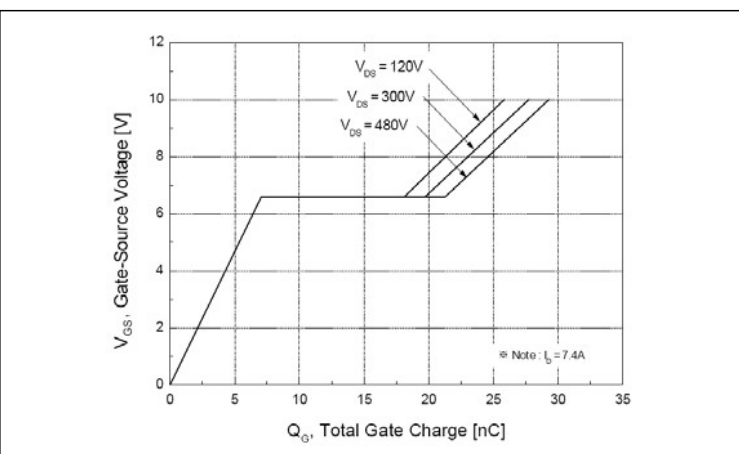


Figure 6. Gate Charge Characteristics

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Typical Characteristics (Continued)

$T_J = 25^\circ\text{C}$, unless otherwise noted

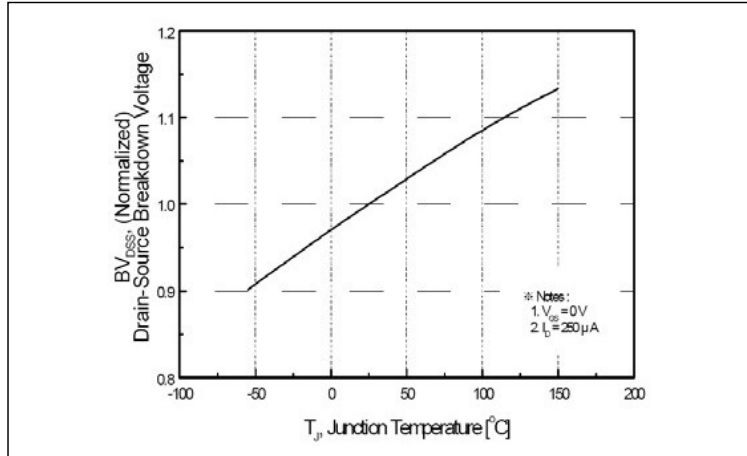


Figure 7. Breakdown Voltage Variation vs. Temperature

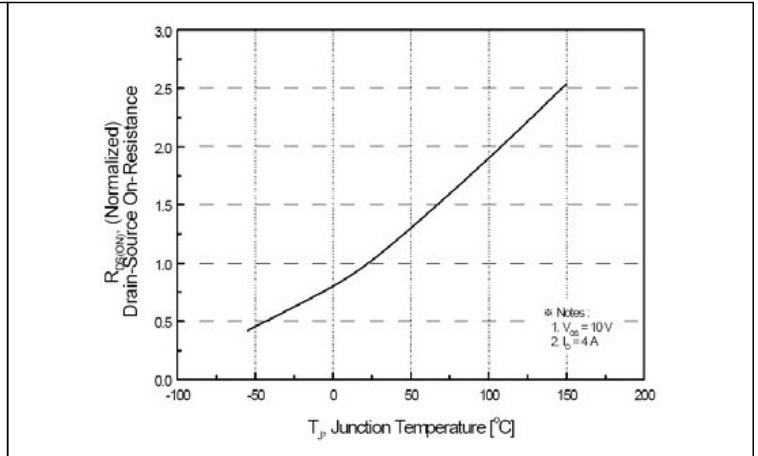


Figure 8. On-Resistance Variation vs. Temperature

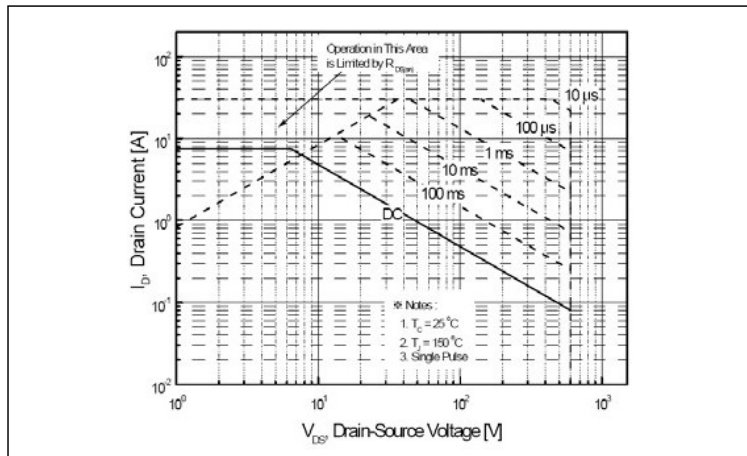


Figure 9. Maximum Safe Operating Area

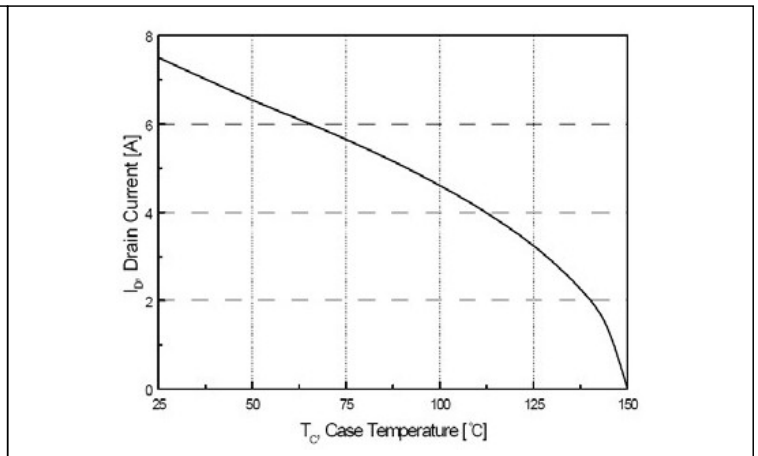


Figure 10. Maximum Drain Current vs. Case Temperature

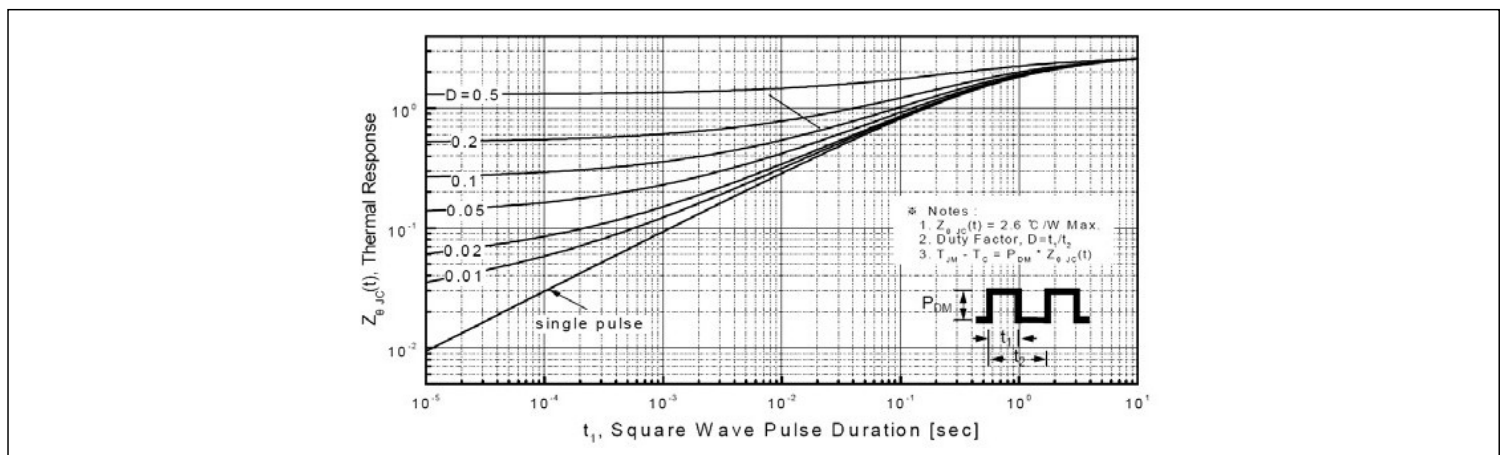


Figure 11. Transient Thermal Response Curve

Test Circuits and Waveforms

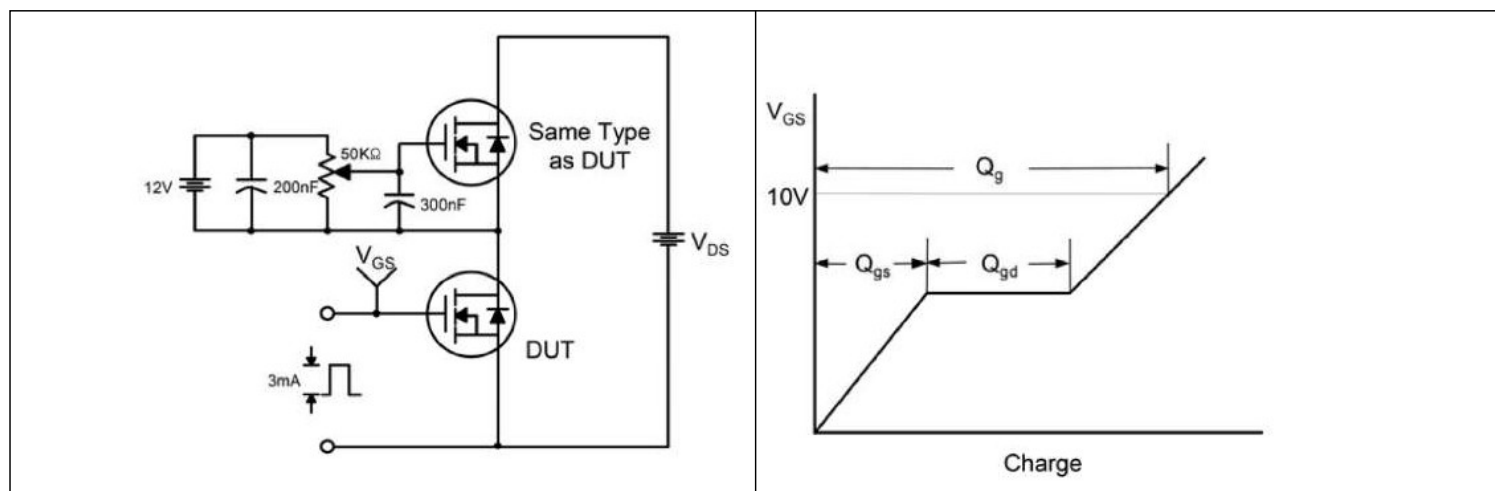


Figure 12. Gate Charge Test Circuit and Waveforms

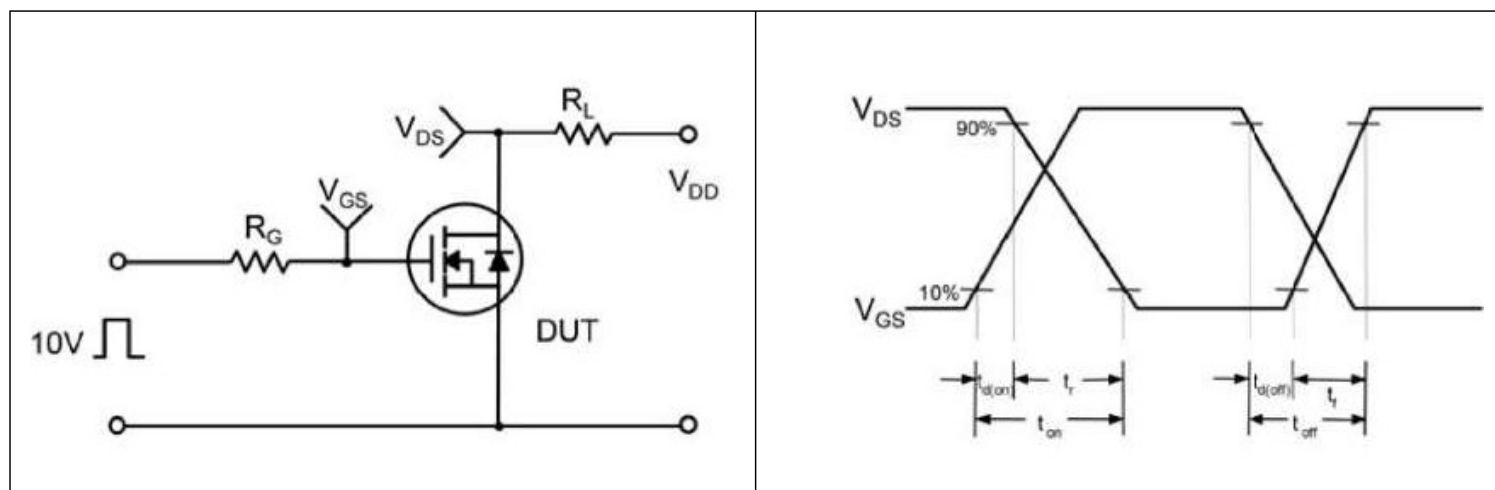


Figure 13. Resistive Switching Test Circuit and Waveforms

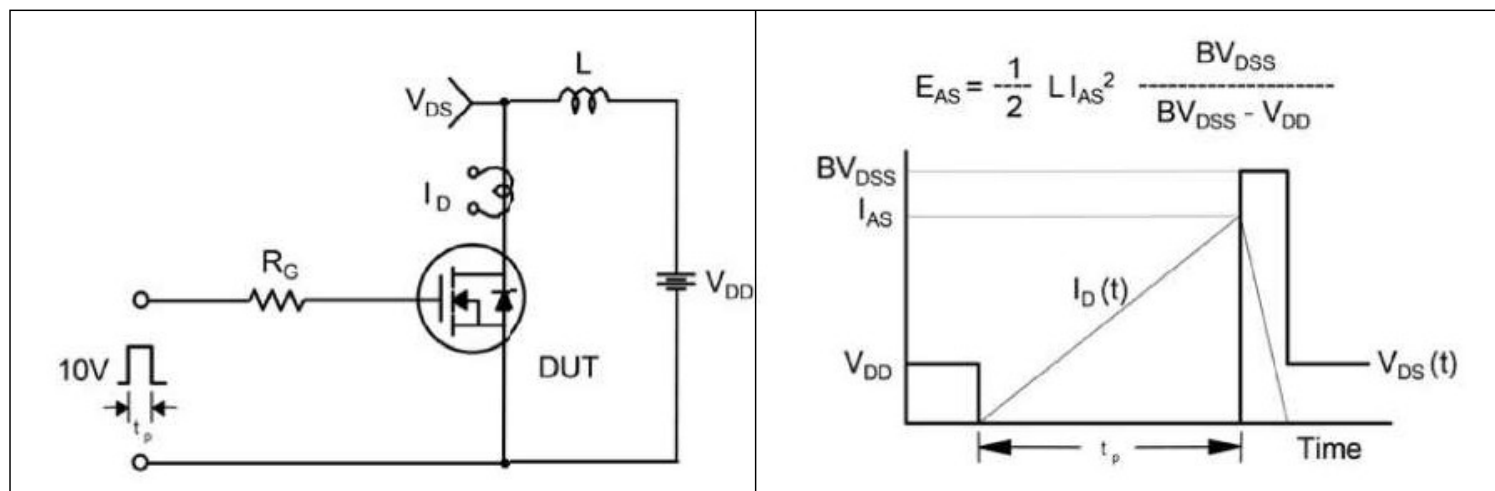
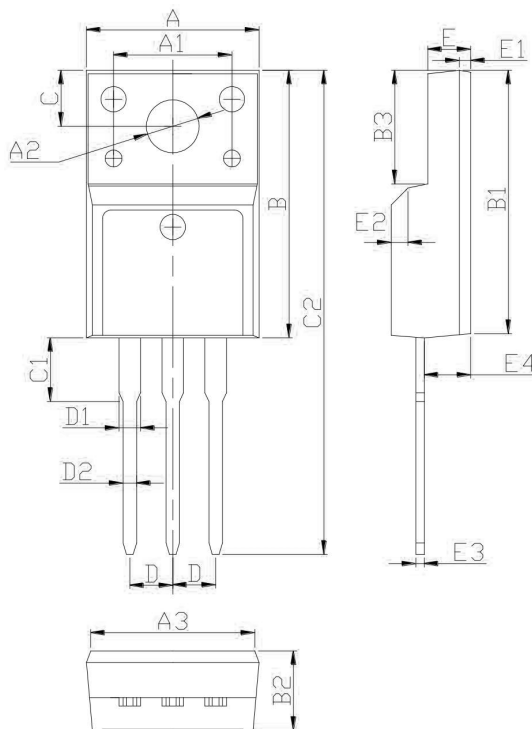


Figure 14. Unclamped Inductive Switching Test Circuit and Waveforms

Package Dimensions

HCR7N65F - TO-220F Package

Unit: mm

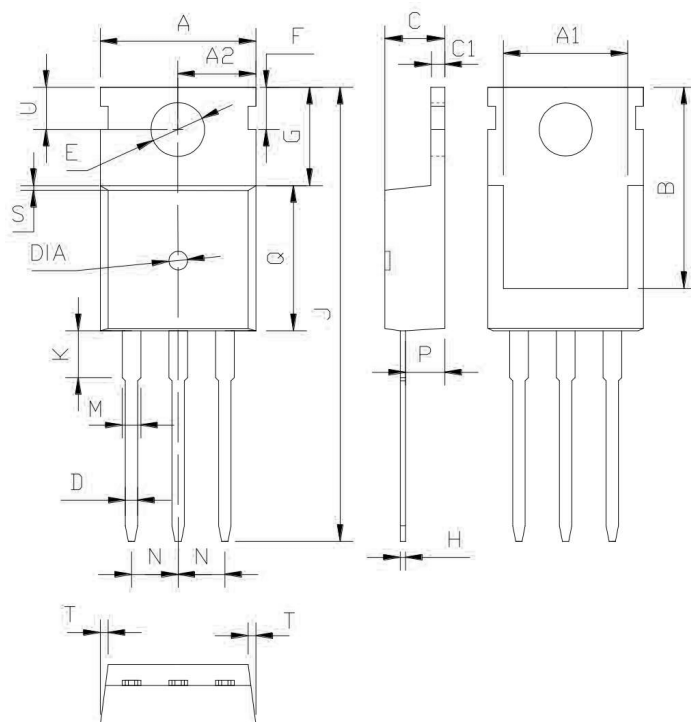


DIM	Millimeters	DIM	Millimeters
A	10.16±0.30	C2	28.70±0.50
A1	7.00±0.20	D	Typical 2.54
A2	3.12±0.20	D1	1.47 (MAX)
A3	9.70±0.30	D2	0.80±0.20
B	15.90±0.50	E	2.55±0.25
B1	15.60±0.50	E1	0.70±0.25
B2	4.70±0.30	E2	1.0×45°
B3	6.70±0.30	E3	0.50±0.20
C	3.30±0.25	E4	2.75±0.30
C1	3.25±0.30	-	-

Package Dimensions

HCR7N65P - TO-220AB Package

Unit: mm

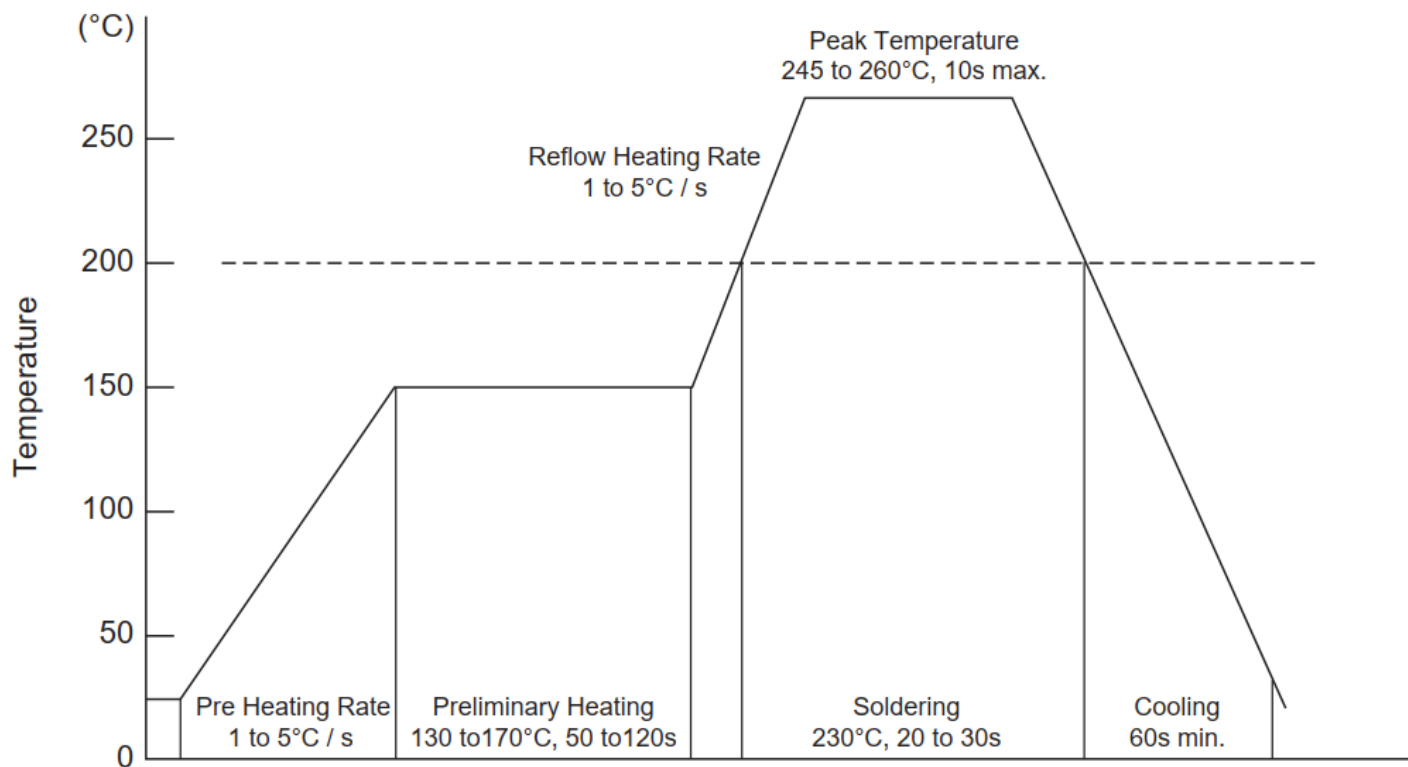


DIM	Millimeters	DIM	Millimeters
A	10.00±0.30	J	28.88±0.50
A1	8.00±0.30	K	3.00±0.30
A2	5.00±0.30	M	1.30±0.30
B	13.20±0.40	N	Typical 2.54
C	4.50±0.20	P	2.40±0.40
C1	1.30±0.20	Q	9.20±0.40
D	0.80±0.20	S	0.25±0.15
E	3.60±0.20	T	0.25±0.15
F	3.00±0.30	U	2.80±0.30
G	6.60±0.40	DIA	Width 1.50±0.10 Depth 0.50 MAX
H	0.50±0.20	-	-

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Conditions of Soldering and Storage

Recommended condition of reflow soldering



Recommended peak temperature is over 245°C. If peak temperature is below 245°C, you may adjust the following parameters:

- Time length of peak temperature (longer)
- Time length of soldering (longer)
- Thickness of solder paste (thicker)

Conditions of hand soldering

- Temperature: 300°C
- Time: 3s max
- Times: one time

Storage conditions

- Temperature: 5 to 40°C
- Humidity: 30 to 80% RH
- Recommended period: One year after manufacturing